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Editor
Jeffery L. Pederson

Photography
Bill Jack Rodgers, LeRoy N. Sanchez

Public Information Officer
William Richmond

Public Relations Department Head
David L. Moore

Publisher

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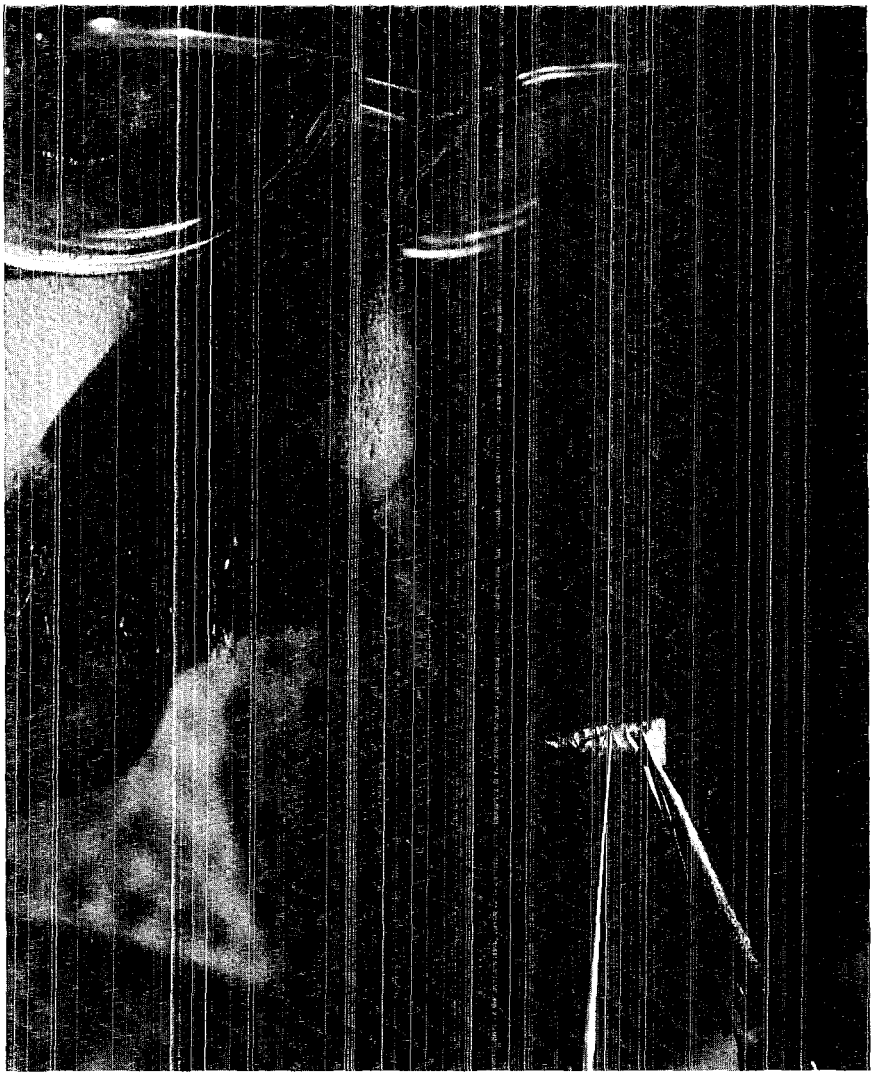
Office

1325 Trinity Drive, Telephone (505) 667-6101. Address inter-office mail to PUB-1, MS 318.

Dividing fact and the fanciful



Jack Fullbright, M-1 group leader, examines the quartz drill found at the Pecos National Monument in ruins classified as prehistoric Rio Grande pueblo. The implement's exact age has not been determined, but archeologists know that it came from a pueblo occupied from about 1300 to 1838. Fullbright's group used scanning electron microscopy to verify the use of the drill, through construction characteristics and wear patterns.

Photos by LeRoy N. Sanchez

By John Ahearne

Technology often expands its benefits in ever-widening circles far beyond original applications. So it was last year when LASL's Nondestructive Testing Group (M-1) came to the aid of the Museum of New Mexico's Laboratory of Anthropology, and provided the weight of scientific evidence for the protection of Southwest consumers.

Jack Fullbright, head of the testing group, was asked by a state consumer protection agency, through the museum, to verify the authenticity of a rug alleged to be traditional Navajo. Soon every aspect of the rug's construction and color — the dyes, the mordants (chemicals that allow the wool to retain dye), and even the structure and weaving of the fibers — came under M-1's scientific scrutiny.

Upon investigation, Fullbright discovered that true Navajo rugs contain only native vegetal dyes, or ones manufactured by the W.T. Cushing Dye Company in Maine.

(The pervasive preference for one brand goes back to the 1870s when a young surveyor for the Santa Fe Railroad named Fred Harvey saw the need for multicolored dyes in Navajo rug making. Being an enterprising sort, he contacted a Civil War buddy — with whom he served in the Maine Volunteers — and ordered the dyes from his friend's fledgling business to be sold in trading posts. Later, Harvey entrenched the tradition of Cushing dyes, selling them exclusively in his own trading posts.)

Fullbright's report: automation produced the rug.

An indicator of the type of dye used is the mordant. Vegetal dyes are used in conjunction with organic mordants, while commercial dyes contain metallic salts. Fullbright found out the metallic salt content of the Cushing dyes.

The Nondestructive Testing Group then analyzed the dyes and mordants of the rug using x-ray fluorescence spectroscopy. In this type of examination, a sample is exposed to x rays causing the chemical elements in the sample to emit characteristic x rays of their own. The x-ray "fingerprint" for each element is unique, and thereby allows the spectrometer to identify elemental composition of the sample.

The test showed that the rug contained metallic salts different from those in the Cushing dye, and since vegetal dyes and organic mordants contain no metallic salts, the rug was likely not the genuine article.

Further, using a scanning electron microscope and an optical microscope, the structure of the fiber and the weave was examined. The scanning electron microscope operates much like the familiar optical microscope except that its image is created by a beam of electrons rather than light.

Fullbright found that the wool appeared hand spun in the Navajo tradition, but that the uniformity of the weave and the number of threads per inch suggested that the rug was woven on a power loom — decidedly not traditional Navajo.

Fullbright's report: Definitely not a true Navajo work of art. Probably made in Mexico. Genuine rugs range in price from $200 to more than $2000. This sample's estimated value — $20.

Projects such as this are, of course, subsidiary activities of the testing group. Its primary responsibility is to provide nondestructive testing support to all divisions of the Laboratory.

Nondestructive testing, as the name implies, is the process of determining the physical characteristics and conditions of materials, components, and assemblies — and consequently their ability to perform to expected standards — without altering or damaging the sample being tested.

"Our type of work is indispensable in any research and development activity that results in a product or assembly," said Fullbright. "It affords a relatively inexpensive margin of safety and product quality necessary in experimental research."

One example of the service M-1 is called upon to perform is verifying the integrity of welded metal seams, Fullbright said. Any manufactured vessels required to perform under pressure will be evaluated by the testing group. Before the piping for LASL's geothermal experiment was lowered deep into the volcanic tuff of the Jemez Mountains, the welded sections were inspected beneath the penetrating beam of M-1's radiographic equipment.

From x rays to sound waves to lasers, the equipment and methods employed by the testing group are as varied as their projects. X- and gamma-radiography as well as ultrasonic (sound wave) inspection can map out the interior construction and contents of both newly manufactured hardware and the archaeological artifact. Surface conditions are checked with liquid penetrants or electromagnetic eddy

The elemental makeup of this bronze bell fragment, excavated from the Palace of the Governors in Santa Fe, was tested with x-ray fluorescence by the nondestructive testing group. The fragment dates back to the Pueblo Revolt period of the 1680s. Every element emits characteristic x rays of its own, allowing LASL to accurately determine its composition.

current inspection. Passive radiation measurement can pinpoint the amount of a radioactive element in a sample. Noise monitoring — testing for acoustic emission — determines stress points in metal.

But even with the myriad of LASL duties assigned the group, Fullbright has actively sought to assist industry and public organizations with their nondestructive testing needs.

"Traditional testing techniques can be applied to a wide variety of disciplines — such as archaeology and medicine," Fullbright said. "And in keeping with LASL's policy of technology transfer, we welcome the opportunity to introduce the techniques at our disposal to other areas of scientific investigation."

And the recipients of this technological transfer couldn't be more delighted. David Snow, the curator of Museum of New Mexico's Laboratory of Anthropology, termed nondestructive testing "a fantastic tool" now available to the archaeologist.

"One can determine only so much by visually examining an artifact. It is an exceptional advantage to be able to characterize an artifact in terms of the parameters afforded by nondestructive testing," said Snow.

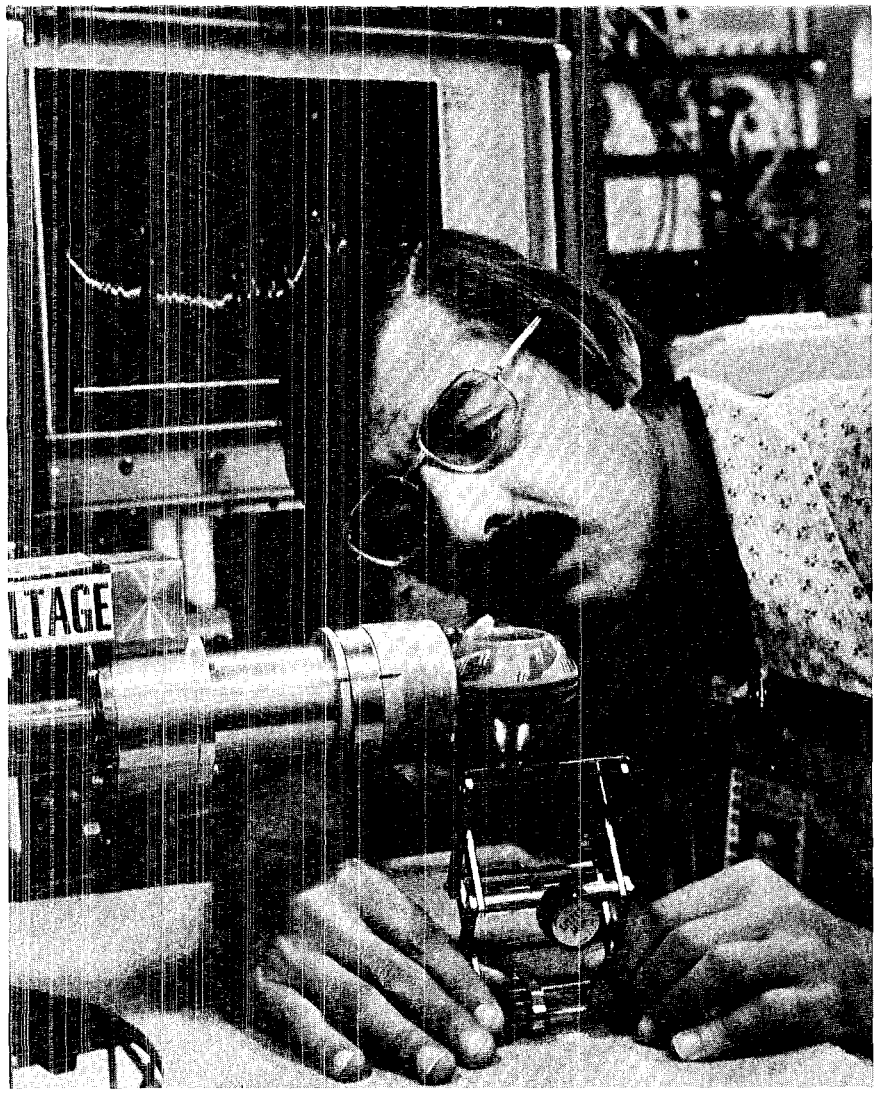
Analyzing such components as dyes, paints, and clays using LASL technology has greatly enhanced the characterization and classification of artifacts, said Snow. Often the nondestructive techniques can help the archaeologist pinpoint the geographical origin of a sample, the time period in which it was manufactured, and sometimes even the group of artisans who created the artifact.

For example, Fullbright's team, working with the Anthropology Laboratory, has been able to establish definite relationships between certain pottery types and their regions of manufacture. In the clay paste, significant variations, determined by x-ray fluorescence analysis, were observed in the concentration of certain elements. Knowing the origin of the samples, and correlating the results of the analysis, the archaeologist can accurately determine the origin of other, untested artifacts.

'This is a fantastic tool'

Further, the study of lithic artifacts (stone tools and implements) is providing much information on methods of manufacture and the spread of this technology through trade or travel. In this instance, not only does x-ray fluorescence determine the makeup of the stone, but the scanning electron microscope produces a finely detailed picture of the technique used in creating the lithic artifact. Using correlation and comparison, the archaeologist can significantly expand our knowledge of prehistoric trade and travel patterns.

Fullbright continues to seek outside projects for the testing group including a proposal that hopes to unravel one of the proverbial mys-



Placed before the beam of the x-ray fluorescence radiograph, a contemporary Rio Grande red ware pot is tested to determine the composition of the clay used when it was created. Data obtained will be compared with prehistoric Rio Grande pottery clays, in an effort to relate the two materials.

teries of the Orient.

The object of the proposal is a dark, thin monolith that stands in the courtyard of a palace in the Qutab Minar section of Delhi, India. Legend has it that should the "Delhi Pillar" fall, India shall fall.

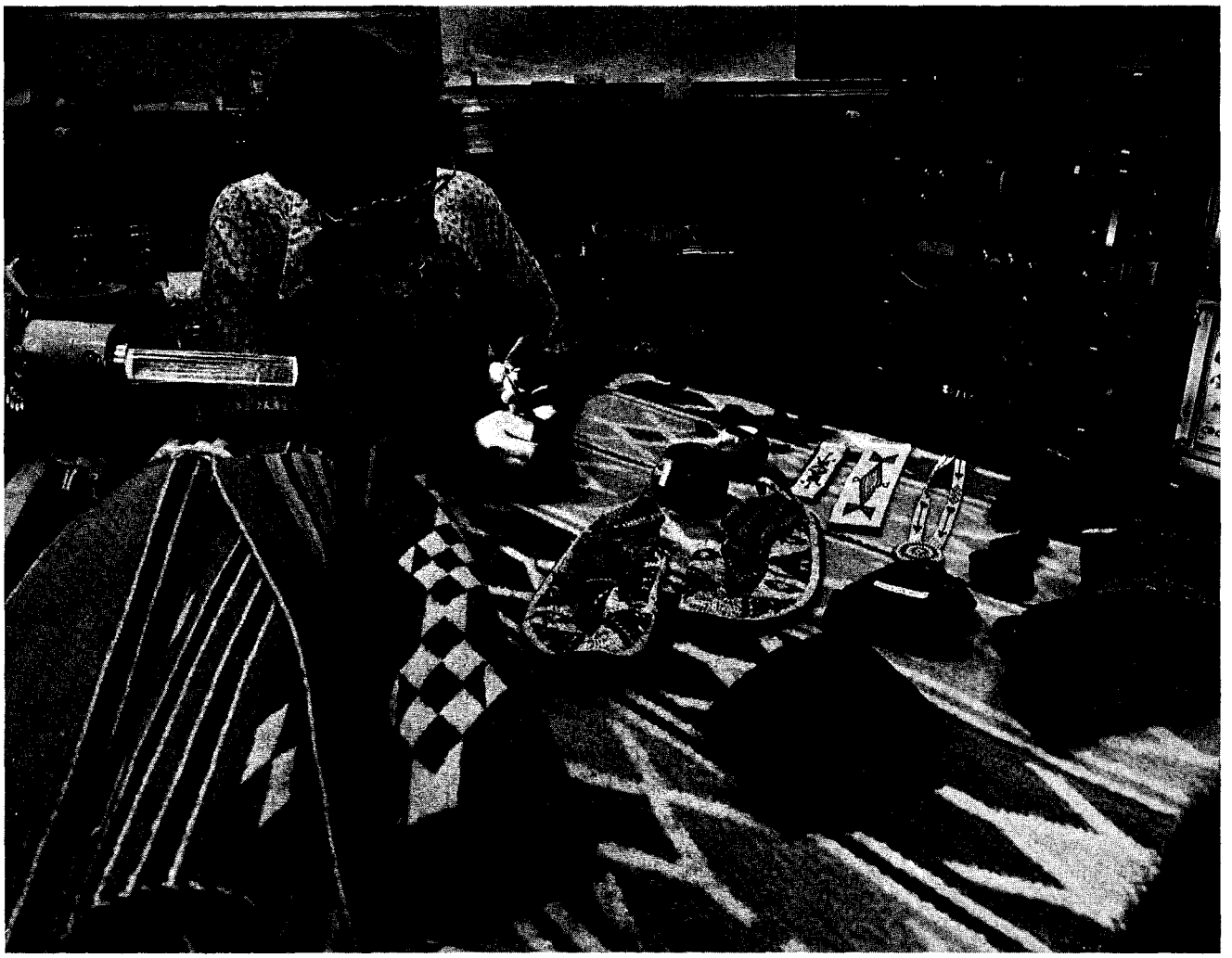
And, indeed, through nearly 16 centuries, the 23 foot tall, 16 inch diameter tower has stood. What is most remarkable, the pillar — thought to be composed of almost pure iron, and standing for countless eons amid the swirling monsoon rains of a seasonally humid, subtropical country — has resisted corrosion and rust.

Coming from a country of gurus and yoga, this may well sound mysterious. But to the Fullbright group (and metallurgists from LASL's Chemical Materials Science Division) the "mystery" is simply another scientific curiosity that can likely be explained using nondestructive testing methods. Application of what might be learned could be of direct value in both resource management and archaeological study, said Fullbright.

"Iron is derived from dwindling ore reserves, and corrosion not only depletes a valuable mineral, but squanders the energy required to produce replacement metal," he said. "Any process that reduces rust by even a very small amount would be worth investigating.

"From the archaeologist's viewpoint, a deeper understanding of the ancient techniques used in its construction could be expected from the study."

From a pottery shard in the American Southwest to an iron pillar on the other side of the globe, and from consumer protection to metallurgy, the Laboratory's Nondestructive Testing Group provides an intriguing brand of technology transfer with the ancient being analyzed by the latest of modern machinery — with the gadgetry created on the frontiers of science surrounded by the tools, metals, fiber, and bones of prehistory.



Fullbright examines a collection of typical artifacts tested by M-1. The rugs will undergo examination to assay the dyes and mordants used in the colors. Elemental contents of metal and clay fragments will be correlated with results from previous tests. Beads and pots of contemporary origin will be classified so their characteristics and origins can be compared with others from different times.

Glittering faces, Einsteinian magic

Bill Dunning photo

Subrahmanyan Chandrasekhar and his wife (right) spoke with Nicholas Metropolis and David Sharp, Oppenheimer Committee chairman, at a Fuller Lodge reception last month.

Einstein's general theory of relativity presents "glittering faces at every turn" and is rich in content, the 1978 speaker at the Oppenheimer Memorial Lecture said August 17. It's also true that "anyone who understands the theory can't escape its magic," said Subrahmanyan Chandresekhar, eminent astrophysicist from the University of Chicago, who has earned fame for his work on the "black holes" of space.

Although Einstein unified space, time, and matter with papers in 1905 and 1915, his theory was either ignored or neglected in most institutions for decades. Even today, there are persons other than "cranks or pseudo-scientists" who are not convinced of the theory of relativity, Chandrasekhar continued. Alfred North Whitehead has said, "Beauty . . . and even truth will not save the theory from scientific neglect." Writing to the Berlin Academy 65 years ago, Einstein waxed atypically emotional and said his work "represents a genuine triumph."

In science, said the speaker, new theories result because experimental evidence conflicts with what is believed to be true. Einstein's theory, in contrast, waited until 1919 before it could be proven empirically. Isaac Newton's accurate work with pendulums only varied from Einstein's theory by a few measured parts in a billion.

Chandrasekhar recalled a dinner discussion held at Christmastime, 1933, at Trinity College in Cambridge, England. Only five persons were seated at the table during the vacation period, including the famed scientists Ernest Rutherford and Arthur Eddington.

Rutherford, who devised a nuclear model of the atom, recalled that Edwardian and Victorian values were changing in post-World War I England, and said astronomical discoveries had struck a responsive chord in western societies, thus explaining some of Einstein's exalted place.

Eddington, who had sought a conscientious objector deferral from the draft, received a scientific deferral with the understanding he would lead one of two postwar expeditions to test part of Einstein's theory. The goal was to send parties to Brazil and to Principe Island off west Africa, to see if during a solar eclipse the earth's gravitational effect on paths of light could be measured.

From Greenwich, the parties set off in 1919 to make photographic plates. The plates were developed and studied on the spot, and indeed light was found to be "bent." Rumors of the successful trip first reached a satisfied Einstein in September, and the Royal Society met in London the following month to acclaim the results.

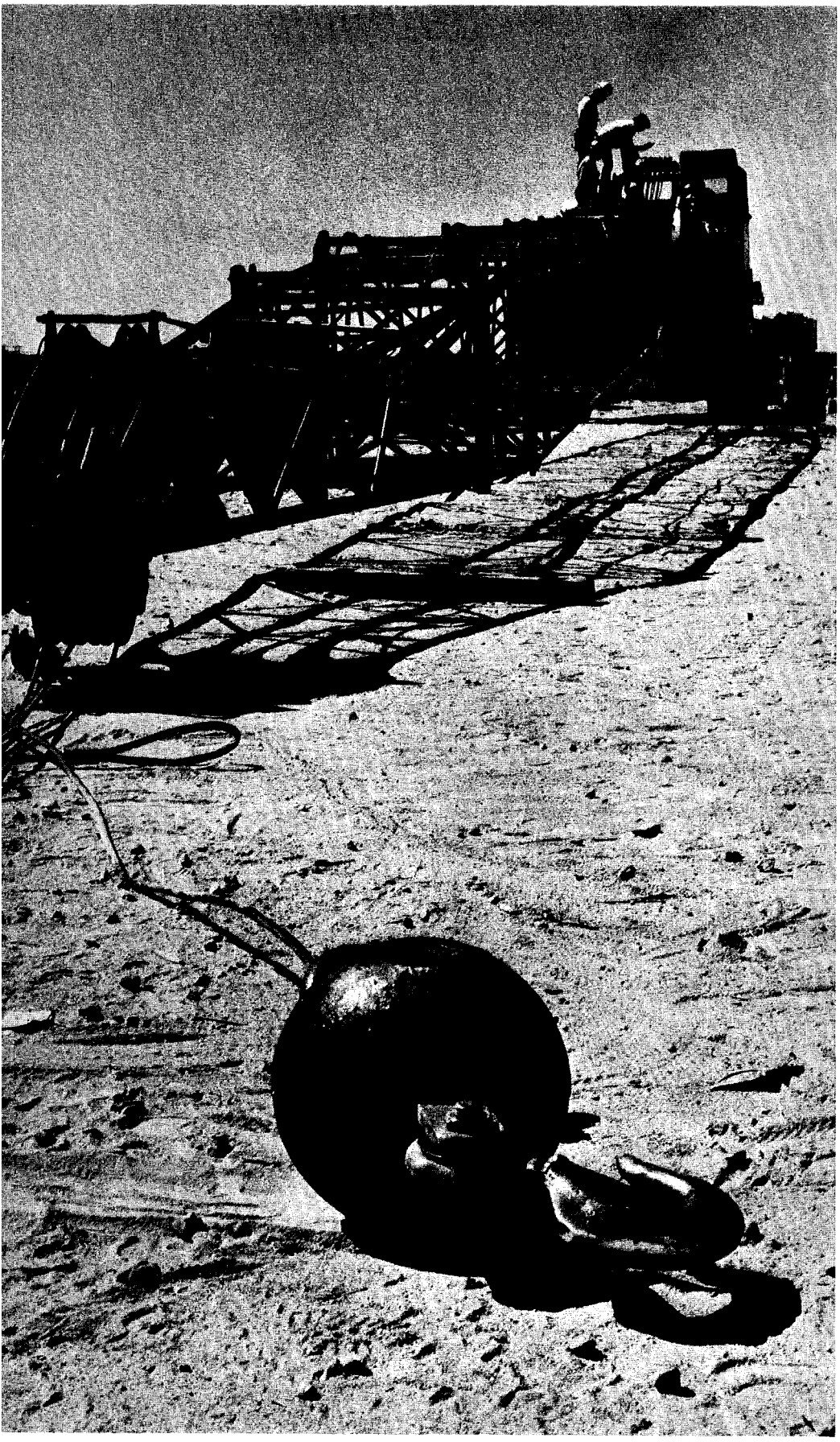
Chandrasekhar said only a "myth" held that just three persons in the world could understand Einstein's theory. New mathematics were required, but such was also the case with quantum mechanics, he said. If it could be calculated that light was deflected 1.7 seconds of arc by the earth's gravity, the theory also could be used when talking about black holes or other nuclear events, he said.

As part of Einstein's paradoxical treatment in history, Chandrasekhar noted a colleague had said as recently as 1955: "It is one of the greatest feats of human thinking, but its connection with experience is slender. It is more a great work of art, to be admired from a distance."

Chandrasekhar was born in Lahore, India, and received a Ph.D. degree from Cambridge University. In 1937, he joined the University of Chicago staff and is currently a distinguished service professor there.

The speaker was introduced by Nicholas Metropolis after opening remarks from David Sharp. The J. Robert Oppenheimer Memorial Committee sponsored a reception at Fuller Lodge following the seventh in a series of special annual lectures.

— **Jeff Pederson**



Hoisting a 30-ton crane

Photos by Bill Jack Rodgers

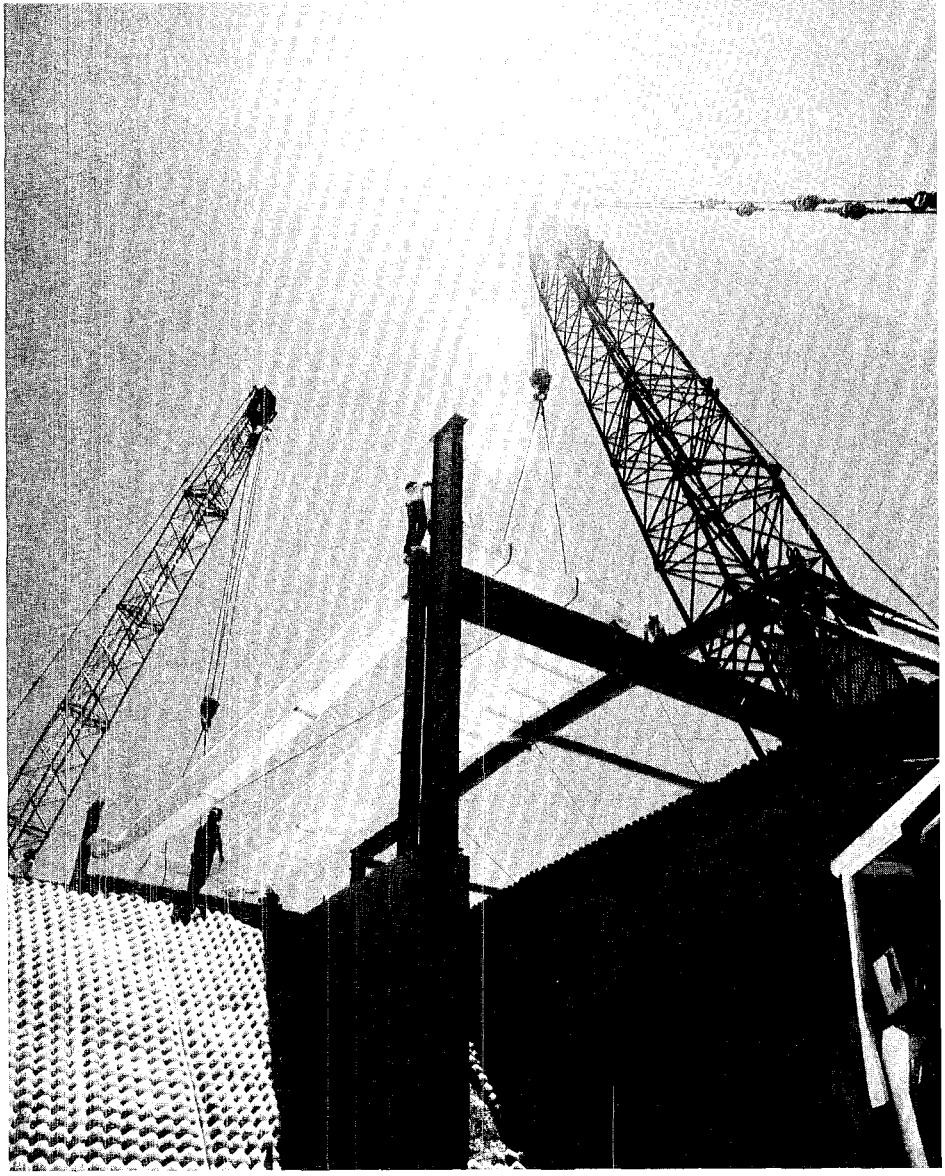
The first phase of construction should be completed by October at the Meson Physics Facility to provide crane coverage and weather protection for the last third of the main beam line. Since 1973, LAMPF has been operating without a building enclosure at the east end of the main line at Area A, the section that serves the biomedical target, the isotope production area, and the main beam stop.

That has meant working nights and in miserable weather to service the area with a regular boom crane, where an operator must attempt delicate tasks in a shielded target area by watching hand signals from someone else -- he can't see what he's working on.

Initial plans called for repairs to be carried out using mobile yard cranes, but MP-Division personnel have faced a difficult problem working on beam diagnostic apparatus, target systems, and vacuum systems in the snow, rain, wind and dust.

Adding to the complication is the fact that most of the hardware is radioactive due to LAMPF's intense proton beam, making remote handling using a device called Monitor a necessity.

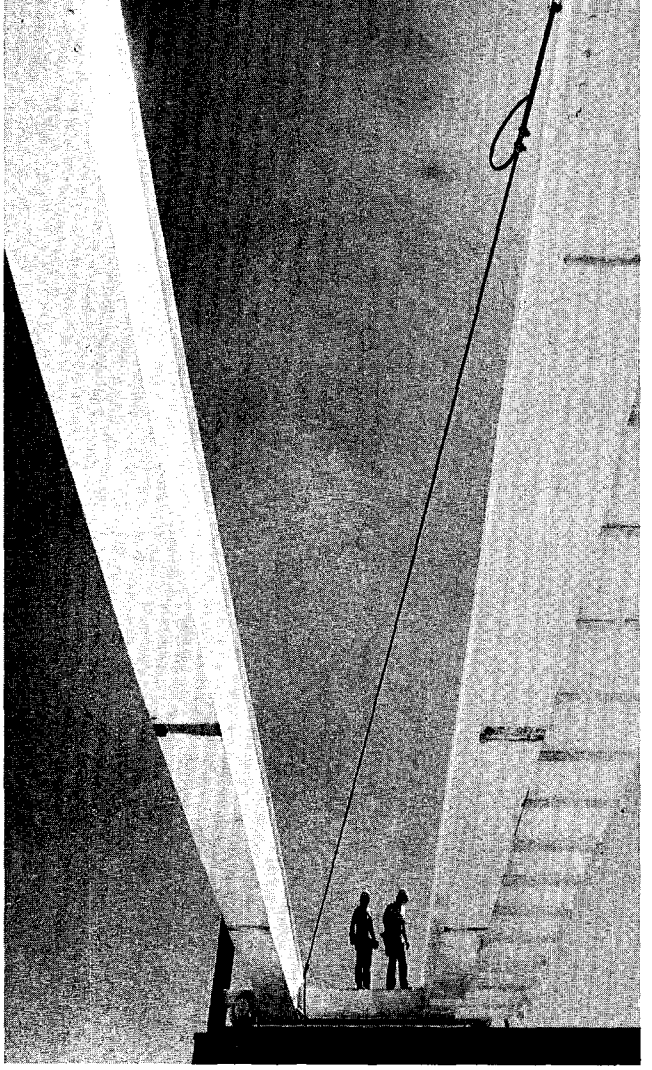
No more. The 30-ton bridge crane installed in August, requiring regular cranes to hoist it in place 25 feet up, can do much more precise work. It now sits on a steel framework and has a span of over 60 feet.

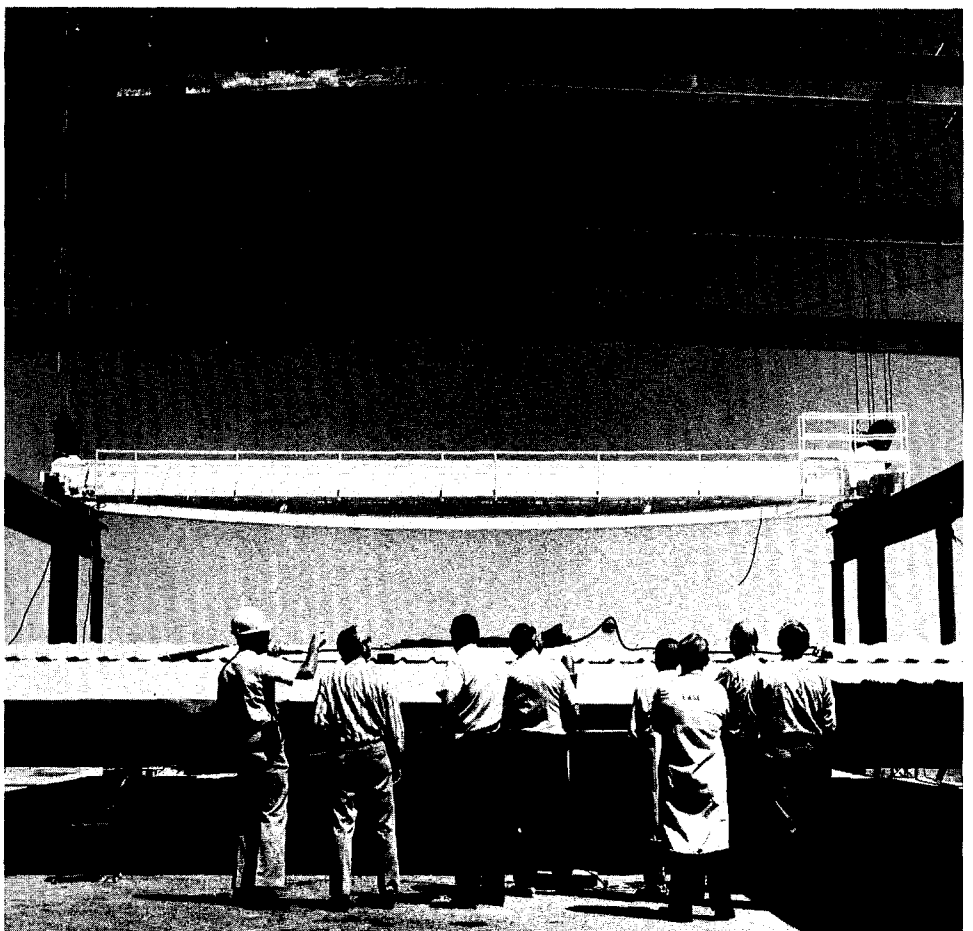


If all goes well, said Lew Agnew and Paul Franke of MP-7, a second phase of construction will provide for a roof and walls for the bridge crane by next summer.

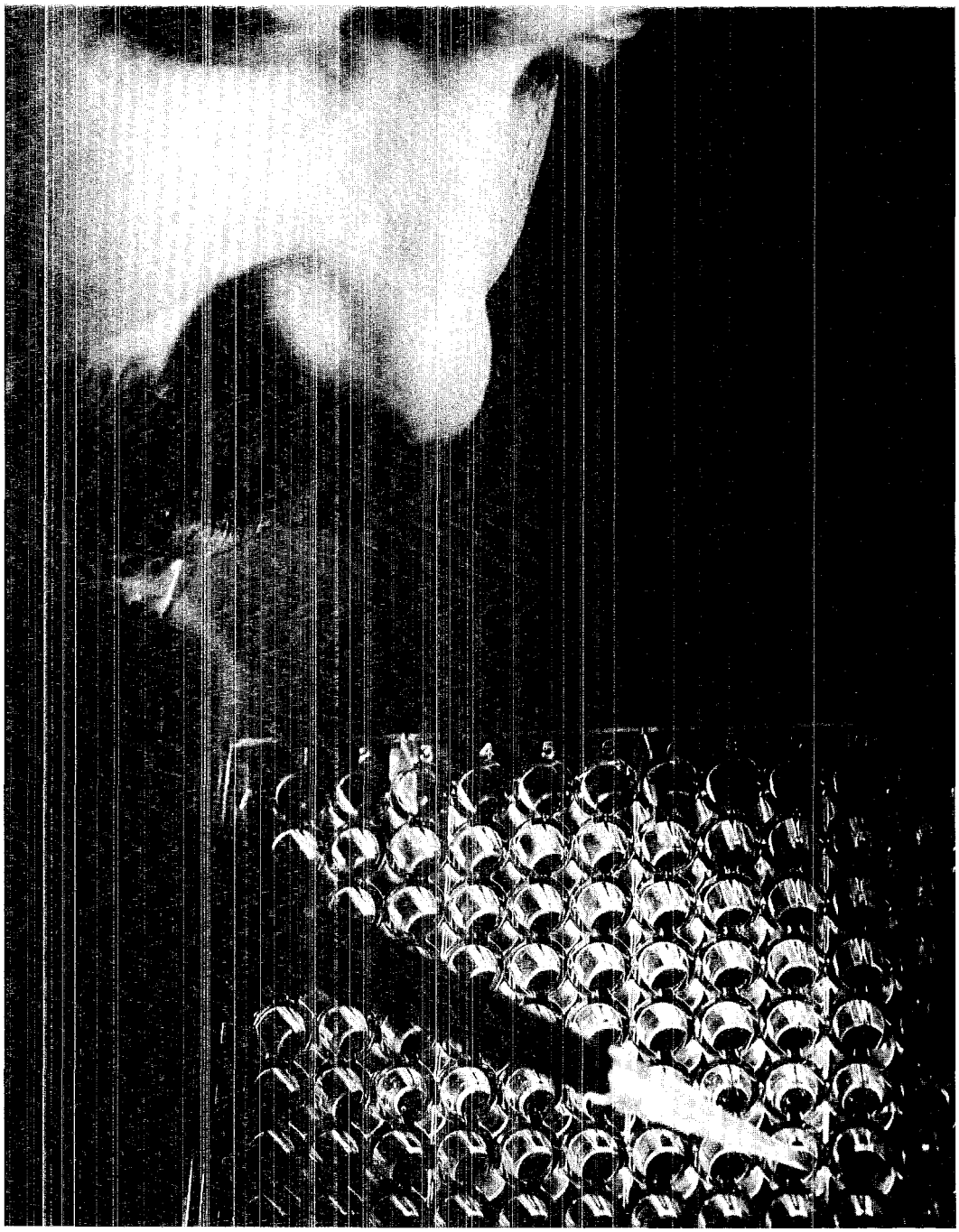
"We are really anxious to live like the other half lives," they said.

Consulting engineers are Randy Holt and Associates of Albuquerque; construction is by Davis and Associates, Santa Fe, both under DOE contract. The large bridge crane was furnished by LASL, with the Zia Co. performing modifications and repairs.





Tests link cancer to body's natural defense system



Using a pipette, Robert Gross transfers cells into an incubation plate — one of the LASL test procedures used to culture lymphocytes used in cancer research.

Could be part of routine treatment within five years.

By Jeff Pederson
and Barb Mulkin

LASL researchers will travel again this month to Grand Junction, Colorado, to draw small blood samples from 60 patients as a collaborative cancer diagnosis study continues with physician Geno Saccamanno. The resultant laboratory tests – based on altered functions of the body's natural defenses – can reliably show whether signs of cancer are present.

The new tests are based on a direct link between the onset of cancer and the malfunction of a patient's "T-cells," a type of lymphocyte. When they function correctly, T-cells (thymus-derived lymphocytic white blood cells) play an integral part in protecting against diseases, including cancer.

When cancer does develop, the T-cell population has diminished ability to destroy malignant cells.

Robert Gross, David M. Smith, and Robert Thomas, H-4, say the Grand Junction trip is expected to bolster a major LASL development in immunological testing made within the past year. The study of the Colorado patients is significant because they are the best defined population in terms of pulmonary cell studies in existence.

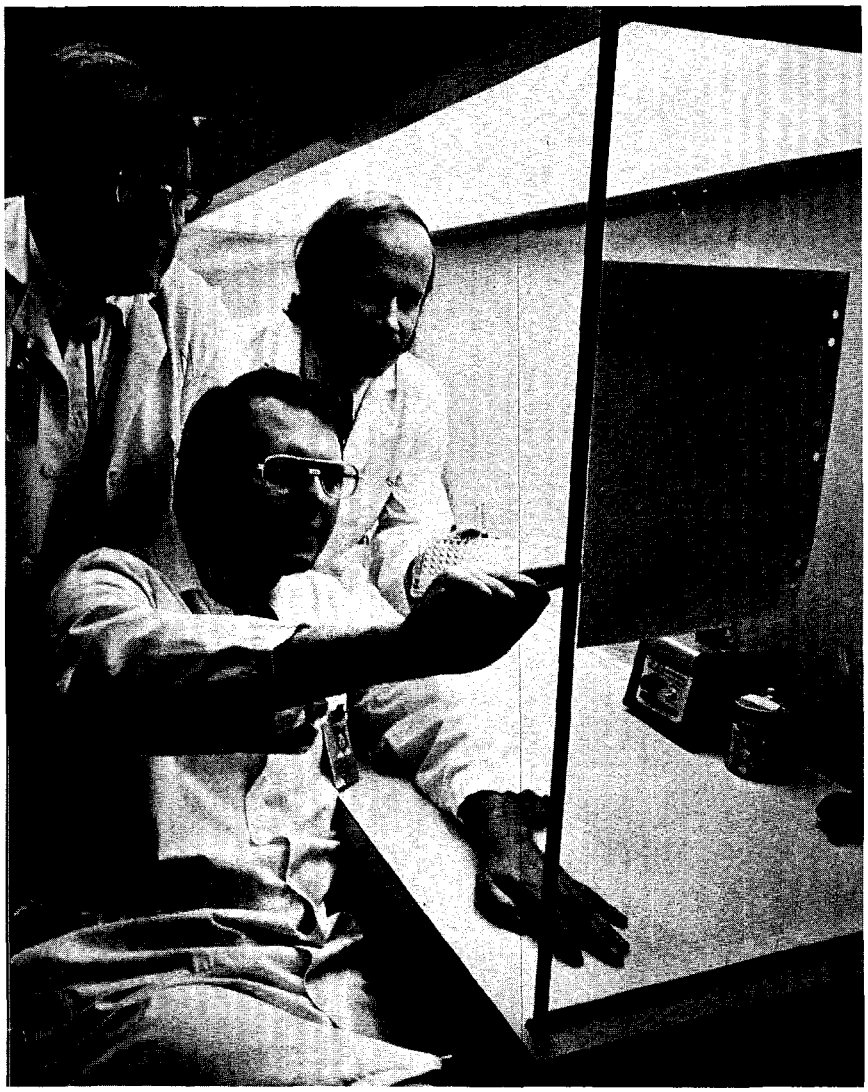
The Laboratory researchers, who pioneered in immunological testing in Colorado with Saccamanno and Richard Saunders of St. Mary's Hospital, say they believe the tests could become part of routine cancer detection and treatment at major medical centers within the next five years.

"Our initial endeavor was to look at laboratory animals," says Thomas, head of H-Division's Mammalian Biology Group. "During the past four years, hamsters and rats were administered carcinogenic materials and subsequent changes in their immune systems were noted. Now, with human testing, we have a rare opportunity to study human and animal reactions simultaneously to make meaningful correlations." This work was performed with the help of Patricia Baron, Glessie Drake, and Jerry London, all H-4.

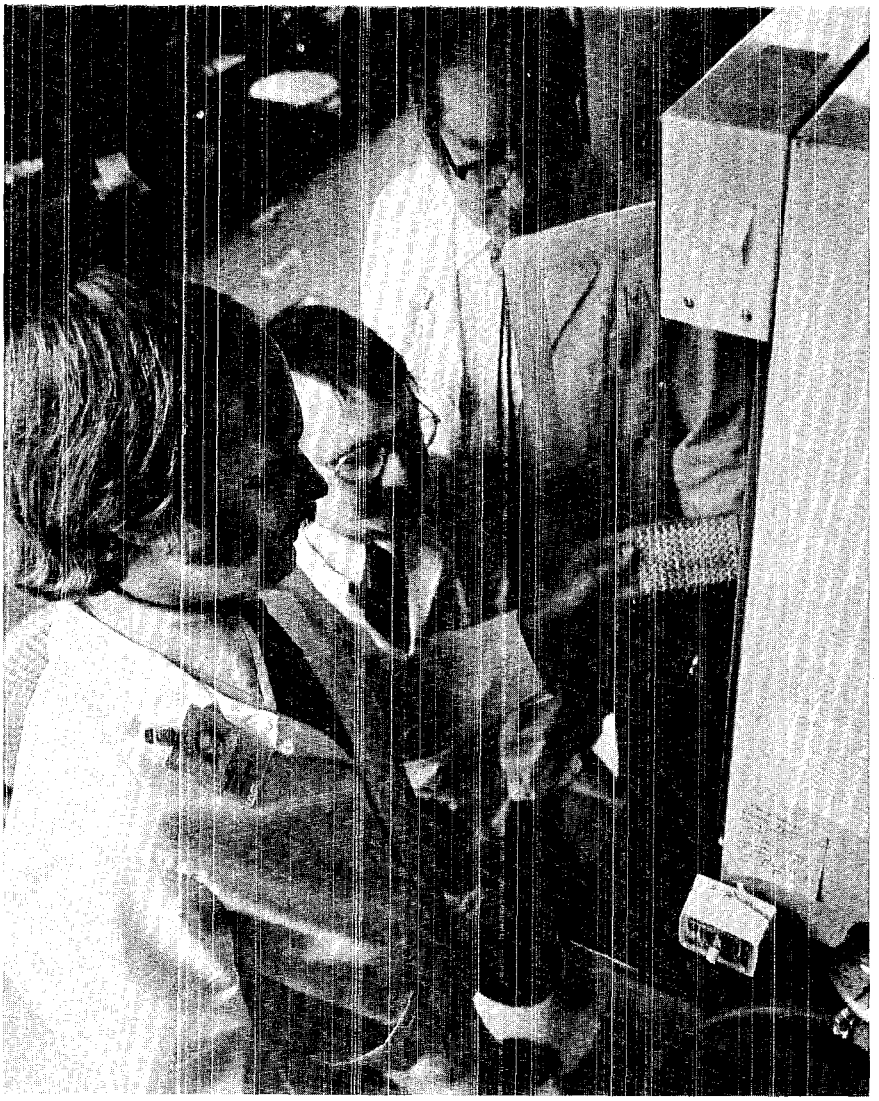
Gross points out that similar immunological tests can be performed with lymphocytes from the spleen, from bone marrow, or from lymph nodes.

"Ten years ago, little was known about these cells," Gross says. "Today, it is established that they are a vital key in the body's surveillance and control of tumor development and growth."

There are actually two major types of lymphocytes, since their precursors can take one of two paths during development. One population migrates to the thymus,



Thomas, Smith and Gross discuss results of tests from the rosette inhibition dilution in the laboratory. Normal persons and cancer patients respond differently to plant extracts that cause cells to divide.



A culture plate is removed from a laboratory incubator. Lymphocyte cells can be combined with plant extracts or with sheep red blood cells to study the health of the body's anti-disease defenses.

Photos by LeRoy N. Sanchez

Lymphocytes probably live for years, have 'memories.'

a gland located above and behind the breastbone, where it is transformed into T-lymphocytes responsible for cell-mediated immunity. The other population follows another, not yet established pathway in man, and becomes B-lymphocytes. These two types of cells work in harmony with one another and with other white blood cells to form the immune system — a primary defense against disease processes.

T-cells are thought to be responsible for surveillance and destruction of cancer cells, viruses, tubercle bacilli, fungi and other disease-causing agents. They act by destroying foreign agents in the body with the help of "lymphokines" — substances released upon T-lymphocyte activation.

B-cells, in contrast, are rallied to produce circulating antibodies and they do not have to have actual contact with the foreign antigen to be effective.

Both types of lymphocytes probably live for years in the body, and they possess "memories" that enable them to remember which diseases have been successfully combatted so that they can continue to maintain an immune state.

A relatively small number of cells are lymphocytes, only one third of the 6,000 to 12,000 white cells in a cubic millimeter of blood. When LASL scientists conduct a test, they draw off a 20cc sample and combine it with heparin, an anti-clotting agent. The sample is first centrifuged to remove the plasma, and the white blood cells are suspended in a buffered salt solution. The cell suspension is layered on a special gradient (ficoll-hypaque) in a test tube and centrifuged again.

All of the cells, except for the lymphocytes, are spun to the bottom of the tube, and they can be quite easily drawn off with a pipette, to be washed and resuspended in a buffered salt solution.

In the laboratory, 100,000 to 200,000 cells from the sample are incubated with plant extracts called "mitogens" that induce these cells to divide — this process is similar to what happens in the body when lymphocytes are exposed to foreign antigens. By adding labels (DNA precursors that are radioactive), scientists can determine the ability of T-cells and B-cells to respond and undergo division.

"Patients with cancer have lymphocytes with a lower ability to respond to these mitogens," Smith says. "The percentage of T-cells in a sample can be determined by incubating the lymphocytes with sheep red blood cells," he explains.

"T-cells have receptors that spontaneously bind these red blood cells, forming clusters called rosettes. Anti-T-cell serum can be included in the incubation mixture, to determine to what degree binding occurs. Normal patients need large amounts of the serum to inhibit binding; cancer patients need only four to 10 per cent as much anti-T-cell serum for inhibition."

B-cell numbers are established by incubating lymphocytes with sheep red blood cells that have been coated with antibody and with complement (the principal chemical mediator of the inflammatory process and immune functions).

Normal patients have circulating T-cell levels of 55 to 65 per cent and B-cell levels of 20 to 25 per cent of the total lymphocyte population, while the values in cancer patients are typically 30 to 40 per cent and 15 to 20 per cent respectively.

Earlier work in immuno-suppression and cancer has been confirmed at LASL and is being expanded to include work with Saccomanno's patients in Colorado. Saccomanno pioneered early lung cancer detection and developed the standard test for detecting the disease in abnormal cells sloughed off in sputum in the respiratory tract. He has worked with lung cancer patients for more than 30 years.

Gross, an M.D. who worked with the World Health Organization in East Africa with Peter Brain, used a rosette inhibition test to determine that a correlation existed between T-cell activity and the course of cancer in children who were victims of the rare Burkitt's lymphoma.

"In every case," says Gross, "the T-cell population was depressed as the disease progressed. T-cell activity picked up as the tumor was treated." At Massachusetts General Hospital in Boston, Gross later used the same test to predict malignancy in patients whose chest x rays showed abnormalities.

Gross and Smith, a veterinary doctor and former MIT faculty member, developed the animal model used to test immunological functions, after Gross became a staff member at LASL. They then refined the unique method of predicting malignancies in animals and in humans.

The basic tests take four days to perform, and the rosette inhibition test can yield results in about six hours. The equipment is commercially produced, and can be readily transported for clinical testing.

LASL researchers equipped a laboratory in Dr. Saccomanno's Grand Junction Hospital, and about 200 patients have been "worked up" in a clinical study that has drawn enthusiastic response from the medical community. They plan to monitor patients undergoing radiation therapy at Grand Junction, and will then begin clinical use of the tests on selected patients in Wyoming, and in an expanded study in Utah.

"We feel with the proper surveillance, we can find out when immune systems fail," Gross says. "Eventually, we think we can marshall the lymphocytes from a static to an active role, sublimating the disease. It will take time and hard work, and the help of Saccamanno and his staff."

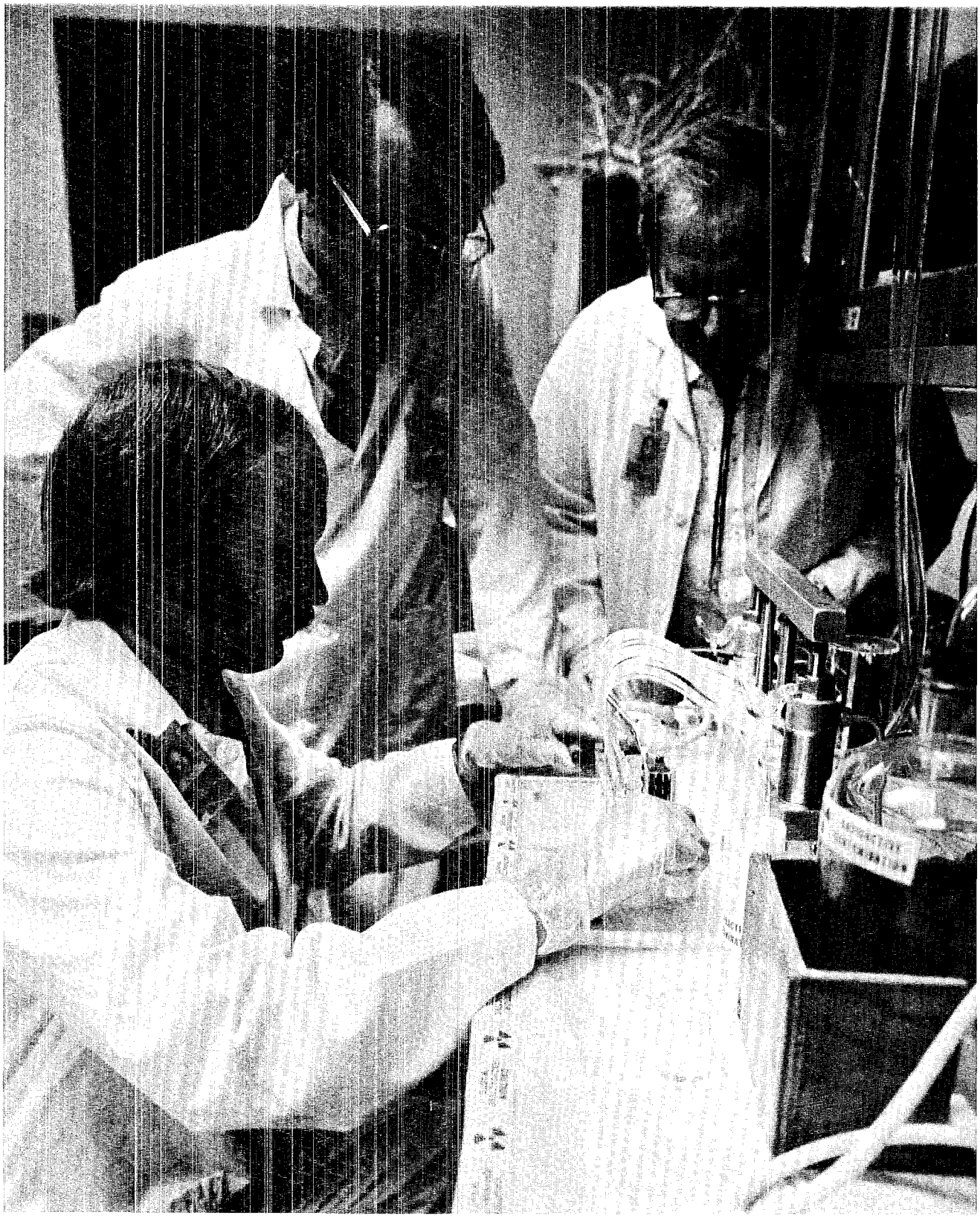
What is not known is whether the defect is caused by the cancer, or if the cancer develops because the immune system goes awry.

The crux of cancer immunology is the notion that tumors start as a single cell, and that more cells undergo malignant transformation than become tumors. It is now clear that defects in the body's immune defense system are connected with cancer.

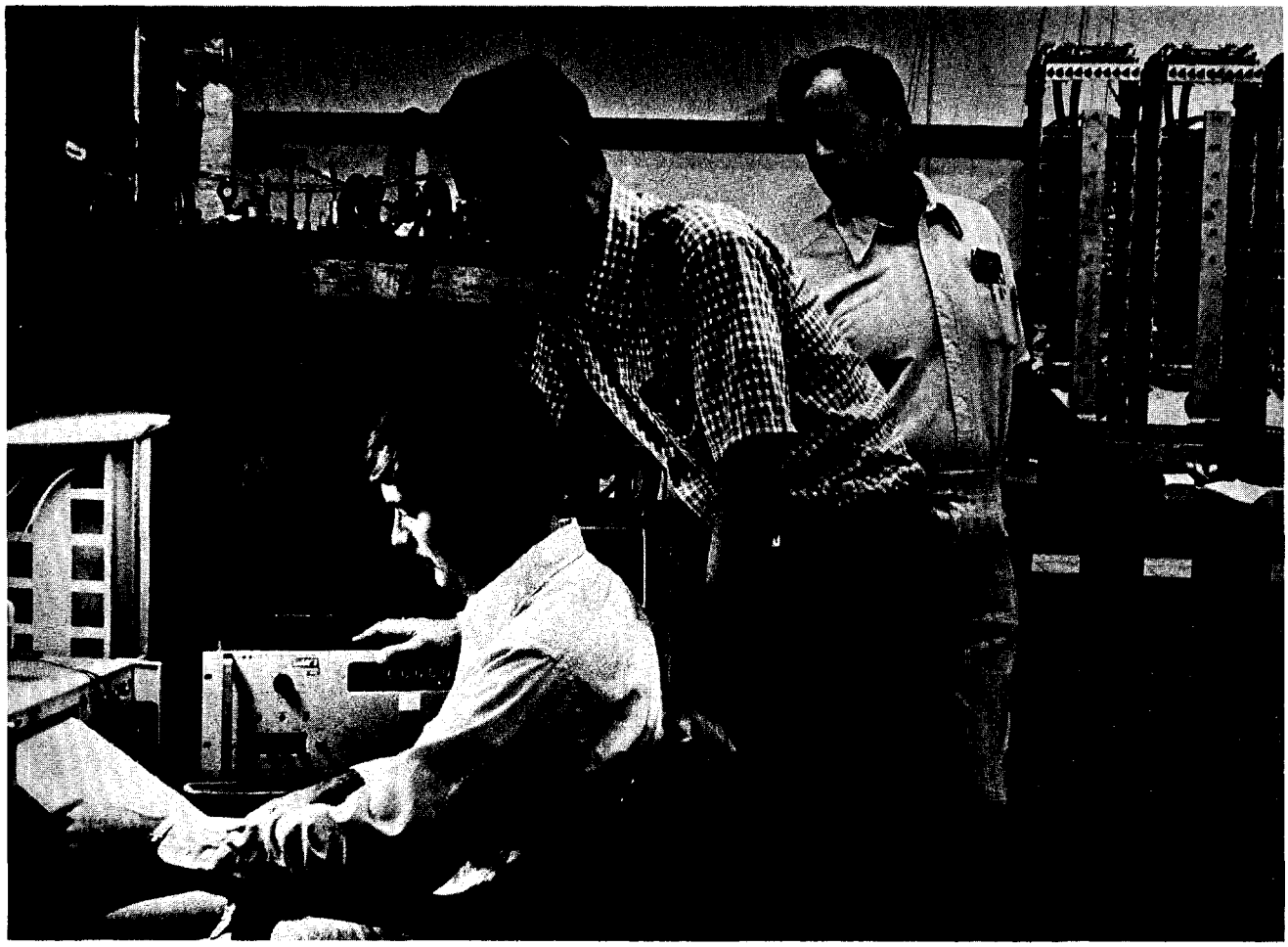
What is not known at this time is if the defect is caused by cancer, or if the cancer develops because something goes awry with the body's immune system.

The scientists believe that the LASL tests can be used to screen members of the population to determine whether a malignancy exists, or is likely to develop, even before other symptoms arise. A comprehensive diagnostic regimen, based on the patient's environment, habits, and family history can then be carried out to locate the site of the cancer. Clinical screening for cervical cancer, for instance, is underway at Emory Medical School in Atlanta, Georgia, under the direction of Mariano LaVia.

"In five years," says Smith, "you're going to see every major medical center run these profiles. It will be an integral part of cancer diagnosis and treatment."



Lymphocyte cells are harvested after a culture test of 72 hours has been run. Human blood contains a relatively small percentage of these cells, which are then extracted in a complex laboratory procedure.



Mark Bowden (co-op student), Heinrich Boenig, and Bill D. Smith check results from a coil stability test at the control console. Researchers are interested in how a superconductor behaves as it reaches a normal temperature and then is allowed to return to its low-temperature phase. Large tank with coil and liquid helium is at left rear; portable power supply is at right.

Super-storage for West Coast power lines

By Barb Mulkin

In 1937, the Bonneville Power Administration (BPA) was created by an Act of Congress to market power from the first federal dam on the Columbia River at Bonneville, 40 miles east of Portland, Oregon.

Today, BPA oversees the enormous Northwestern U.S. power grid, where electricity is generated at more than 30 dams and delivered to consumers in Idaho, Oregon, Montana, Washington, and heavily populated southern California.

The Pacific Northwest and Pacific Southwest are interconnected

by a unique 800-kilovolt direct current (dc) line -- the first major dc line in the nation and still the longest -- and two 500-kilovolt alternating current (ac) lines, looping more than 800 miles along the nation's scenic west coast.

The sheer length of the high voltage overhead transmission system causes a problem that is inherent in electric power systems that carry major loads between widely separated generating centers. A rule of thumb might be: the longer the line and the greater the amount of current carried, the more severe the low-frequency oscillations that can lead to trouble in the system.

BPA engineers have developed a method for quenching the Western system oscillation by using the Pacific high voltage direct current intertie (HVDC), much the same way as a shock absorber works to give automobiles a smoother ride. LASL and BPA scientists believe that this capability can also be obtained by use of a superconducting magnetic energy system (SMES). The concept was proposed by Lee Cresap of BPA and Bill Hassenzahl, a LASL staff member presently on sabbatical leave in France.

Bill Keller, head of LASL's cyrogenics group (Q-10), says funding is being sought to construct a superconducting magnetic energy storage system to be installed on the north end of the transmission system. By modulating the current in the lines, the SMES device would stabilize them and allow transmission of up to 2500 megawatts of electricity on the 3500-megawatt-rated lines.

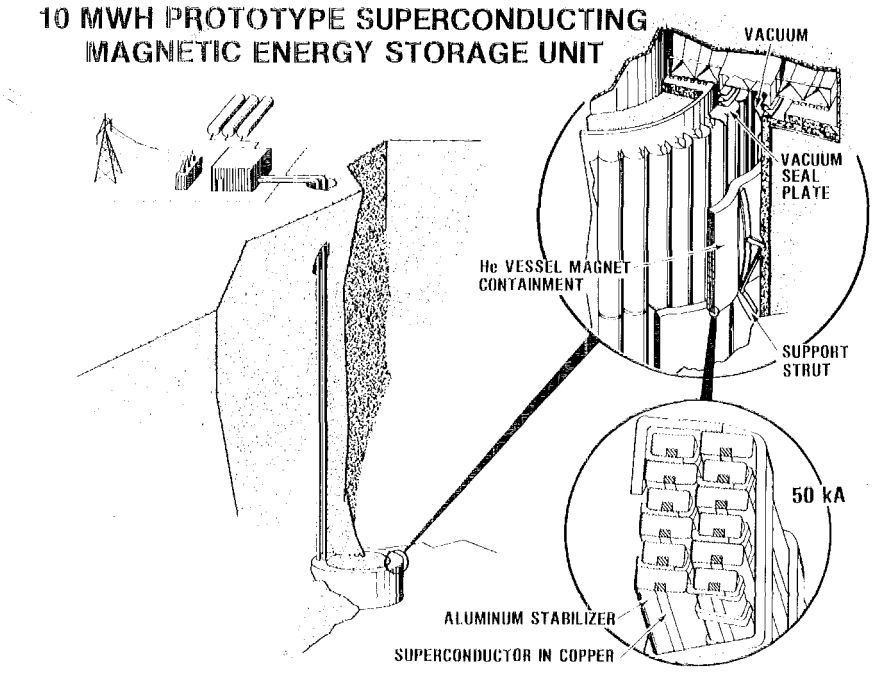
Traditionally, power system stabilizers used to "damp" oscillations on most genereators in the Western U.S. power grid have allowed increased transmission of 2100 megawatts; without the stabilizers the long ac lines can carry only about 1400 megawatts before oscillations become a problem.

John Rogers, manager of LASL's proposed SMES stabilizing development program, says BPA significantly improved the stability of its

Feeds current into lines for stability.

Bill D. Smith, as seen through part of the portable power supply he built. Transistorized water-cooled circuits are part of the controlling system used in the superconductivity stability test. Liquid helium at 4 degrees Kelvin is jacketed around a sample coil in a large tank to simulate possible conditions of actual use. A superconductor loses its properties when its heat increases or when the magnetic field is raised.

Photos by Bill Jack Rodgers



This cutaway shows how a small prototype unit would look, as applied to a city's power load-leveling. It contains all the elements a large unit would have, and would take energy from the power grid network during low demand periods and feed the power back during times of peak demand. The stability device proposed for the Bonneville Power Administration would, in contrast, give out small amounts of power at the right time to dampen oscillations of electrical lines.

long ac lines by using the parallel direct current line to modulate the power flow and smooth out instabilities.

The stable dc line feeds current into the ac lines and absorbs current from them as surges occur. This action smooths current in the ac lines, allowing them to transmit larger amounts of power. Stability is achieved through the use of converters which tie the direct current and alternating current lines together.

"The problem with this method is that the direct current line must be shut down for maintenance periodically — the line is not operating for perhaps 11 per cent of the time," Rogers explains. "Also, there is no backup system to the power system stabilizers and the dc modulated line for use in emergencies."

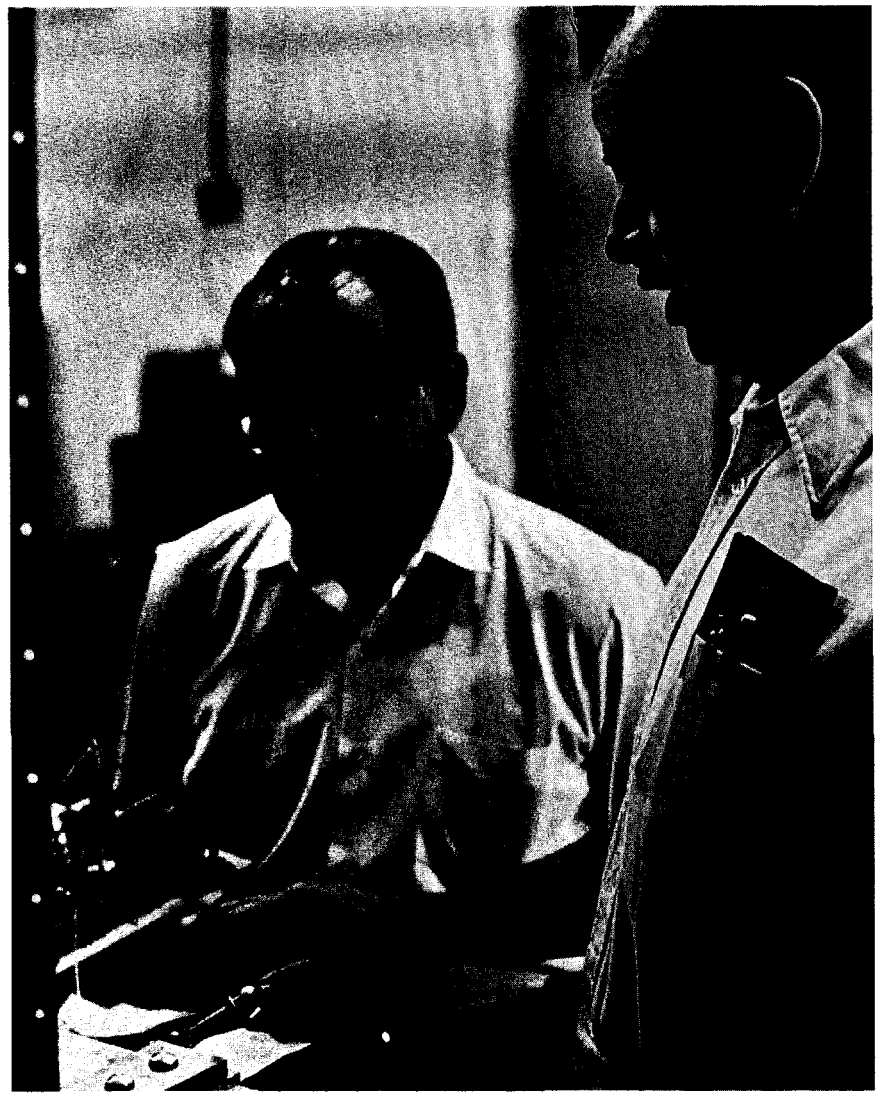
Such an emergency occurred several years ago when an earthquake in southern California destroyed the southern terminal of the dc line, putting the system out of commission for almost a year.

"If the proposed SMES system had been operating on the Pacific ac Intertie, we could have used it as a backup after the earthquake," Roger says, "gaining a considerable economic savings because of the increased capacity of the ac Intertie."

Rogers and Keller believe a SMES stabilizing system could also be used to great advantage in areas where ac transmission systems do not have a companion dc line for power modulation.

There are many such ac systems in the nation, Keller says, and wherever large amounts of power are transmitted over long distances, oscillation can become a problem. If uncontrolled, oscillations limit the amount of power that can be transmitted, and if severe enough, they can put a high voltage transmission system out of operation.

Keller describes oscillations as fluctuations in the flow of electricity in a line. He compares them to a swing in motion. Every time you push a swing, its momentum increases.



Bill Keller, Q-10 group leader, and Bill D. Smith discuss how even a small change in the external electrical circuit can produce a large change in the experimental coil housed in a circular tank.

"As you increase the electrical load on a line, oscillations occur and they can become enormous. In spite of the power system stabilizers in use on the Pacific ac Intertie, oscillations, spanning 300 megawatts, with a frequency of 21 cycles per minute, have been observed during peak use periods," Keller comments.

To correct such problems, LASL scientists, working with BPA engineers, propose to install a superconducting solenoid magnet at the Chief Joseph Substation near Grand Coulee Dam.

Plans call for a 2.7-meter diameter coil storing 30 megajoules of energy. The magnet, if kept cold enough in a dewar of liquid helium, can store energy essentially forever.

The SMES stabilizing system would act as a sponge, according to Keller, releasing and absorbing electricity into and from the ac line as power surges occur, smoothing out the voltage and damping troublesome oscillations.

Although the diameter of the coil and its subsequent storage capacity

Unique for heat, number of cycles

Dean Harkleroad and James E. Harlow work with busbars at the cyrogenics laboratory. A relatively large 3¼ megawatt power supply, as yet unfinished, will be used in future testing.

are not large – there are magnets in existence that store 800 megajoules of energy, and hundreds of cyrogenic systems with dimensions of more than 3 meters – the LASL-BPA system would be unique in the low heat generation allowed, in the extremely short cycling time, and in the large number of times (estimated 10 million) the coil would be cycled in its lifetime.

Many of the components needed for a stabilizing SMES system are available, with some having been developed in the basic superconducting magnetic energy storage program at LASL. This program seeks to provide large storage systems for diurnal load levelling for commercial power systems.

"The stabilizing system is a diversion from the overall SMES program," Keller says. "The engineering would be considerably different, but it would serve as a demonstration of the principal of such storage systems."

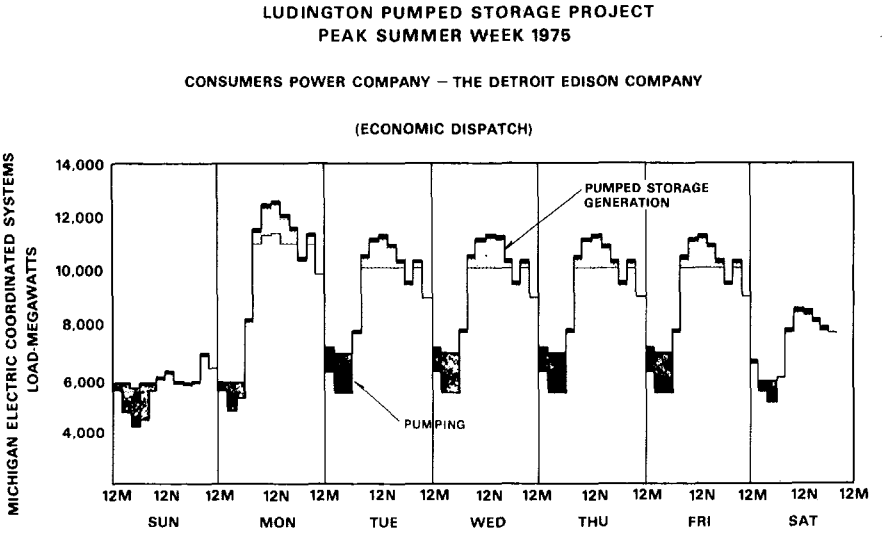
BPA engineers agree. They say the development of this system would provide first-hand practical experience with the storage concept, and also serve the useful purpose of acting as backup to dc modulation. Equally important would be the evaluation of a SMES device for damping on commercial systems where dc line modulation is not available. The economics of such a stabilizing system will be carefully watched by utility companies.

Plans call for a five-year development program, with the SMES stabilizer to be operating at the substation near Grand Coulee in 1983.

The development cost would be minimal for such near-term technology, according to Keller, who says, "The returns in increased efficiency of electric utility power transmission lines are impressive in the long-term."

Funding for the proposed program would be through the Department of Energy and would be part of the enhanced development program of the national superconducting magnetic energy storage effort.

Impressive long-term returns.



"Peaking" of energy demand is illustrated by this typical load curve from the Ludington project in Michigan. Other utilities show similar variations for times of low and high demand. The largest pumped hydro-storage system in the world, Ludington's manmade reservoir 150 meters above Lake Michigan generates electricity at times of peak consumer use and stores the potential energy when demands on the power grid are low.

Bob Schermer, principal investigator of the low-temperature coil tests, discusses some of the many printouts with Bob D. Turner. LASL is interested not only in the material involved, but also in the geometry of the coil winding that must carry heat away from where it is generated.

Short Subjects

John W. Shaner is now the M-6 group leader (shock wave physics). **Carl L. Cuntz, Jr.,** is the group leader of PUB-2 (public relations). At TD-7, **Danny B. Stillman** has been appointed group leader (intelligence). **Robert Y. Porton** is now the assistant head of the Public Relations Department. **William H. Chambers** is associated division leader in Q Division for safeguards operations; **G. Robert Keepin** is associate division leader for safeguards affairs. **John Richter** is now group leader of TD-4 (small weapons design). **C. Robert Emigh** is associate leader of Q-Division, responsible for energy technology.

* * *

Fifteen members of the New Mexico Legislative Interim Joint Committee on Natural Resources toured geothermal energy facilities and waste disposal sites during a visit Aug. 10. Stops included the hot, dry rock project at Fenton Hill and the Union Oil-Public Service Co. hot water site near the Valles Caldera.

An estimated 500 persons showed up August 27 for a public tour of the Tshirege archeological site and ruin near White Rock. It was led by **Charlie Steen**, LASL consultant, and members of the Los Alamos Archeological Society.

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A new group for reactor space power technology has been formed as of September 1, with **David Buden** named acting group leader of Q-15.

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Groups ENG-8 and ENG-10 were combined into one group, ENG-8 (cost engineering) as of September 1. **Hugh Don Orr** is the group leader.

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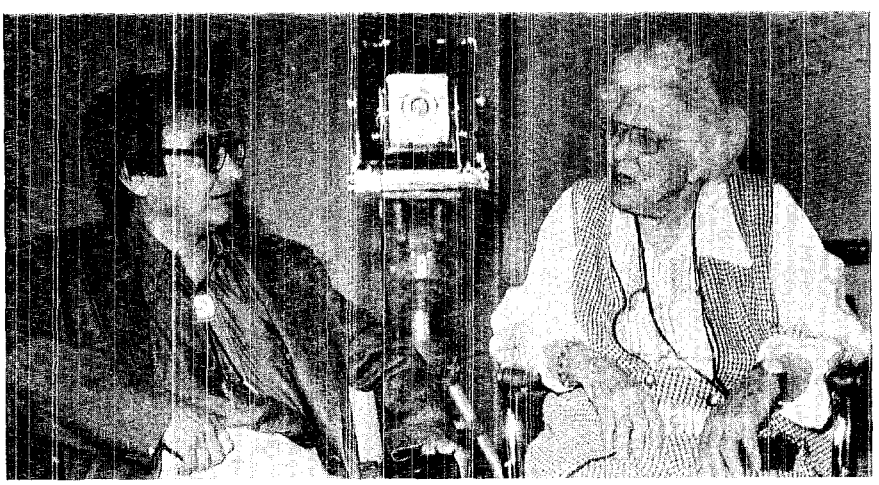
Additions to the services offered by the Public Relations Department include an employee **LASL Newsletter**, published twice a month; an employee **Update** telephone recording, revised daily; and a publication called **LASL Emphasis**, to be printed monthly with a news briefs format.

Carolann Rodriguez photo



Gene Lamkin photo

Famed New Mexico photographer Laura Gilpin visited the Laser Division recently to take pictures of Fred Young, L-4. Her trip to LASL was in response to a British Broadcasting Corporation request for still photographs to be used in conjunction with an upcoming BBC production about Young's work and family history.

Atom has new editor

Jeff Pederson has been named the new Atom editor, replacing John Armistead who is now the assistant group leader in the Public Information Office (PUB-1).

Pederson worked on a variety of newspapers, beginning in 1973, in Minnesota and New Mexico. He co-founded a weekly newspaper in Minnesota and in 1977 won a first place award for reporting in New Mexico. He is a 1971 graduate of St. Olaf College, Northfield, Minnesota.

The new editor has worked at LASL about one year in the Public Information Office, which is responsible for the Atom, the LASL Newsletter, press releases, and interaction with members of the media.

10 Years Ago

LAB STAFF GROWS

The Los Alamos Scientific Laboratory staff grew by 176 and its payroll by approximately $2.8 million during the fiscal year recently ended, according to an announcement made this week. LASL's fulltime staff in Los Alamos passed the 4,000 mark and the payroll was approximately $46 million a year. Lab officials said that this marked one of the biggest increases in staffing in recent years.

LAST OF THE PROPERTIES SOLD

All of the remaining vacant and leased properties in Los Alamos, with the exception of the Community Center, apparently were sold by DHUD at a Monday afternoon bid opening. All high bids, which totaled $637,641, were awarded by DHUD's Los Alamos Community Disposition office. Included were the last of the commercial and residential units offered for sale.

GAMOW DIES

George Gamow, a former consultant and frequent visitor at the Los Alamos Scientific Laboratory, died last week in Boulder, Colorado. He had been a professor of theoretical physics at the University of Colorado since 1956. Gamow was a member of the National Academy of Sciences, a Fellow of the American Physical Society, a Fellow of the Geophysical Union, a member of the Royal Danish Academy, and a member of the International Academy of Astronautics.

APPOINTMENT OF DONNELLY

Lt. General Harold C. Donnelly, (USAF Ret.) has assumed the duties of manager for the AEC's Albuquerque Operations Office. He succeeds Lawrence P. Gise who has retired. Donnelly, during his Air Force service, was Commander, Field Command, Defense Atomic Support Agency, at Sandia Base. Before being named to his new post, Donnelly was director of the Defense Atomic Support Agency in Washington, D.C., a position he has held since January, 1964.

Culled from the September, 1968 files of the *Atom* and the *Los Alamos Monitor*

By Robert Y. Porton

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Jeff Pederson photo

Mary Grace Salas of the Badge Office displays the new LASL clearance badges, distributed in August and September to employees. The government requires its contractors to periodically change badge systems, and the new credit-card-size identifications carry encoded messages in the magnetic strip across the back.

Gene Lamkin photo

The 72-beam laser device called Antares is under construction at Ten Site, and three Laser Division employees show the scope of one of several circular ports — where beam paths will pass from the laser hall building to the target building. Paula Ortiz, Dorothy Donham, and Mary Martinez don't actually work on the construction site, but checked it out recently. Completion of the four-part complex is expected in early 1981; completion of the laser system is planned for 1983.